Pediatric Airway Management Basics

Pediatric Intubation Basics Module I

ICEMA Continuing Education

Introduction

- In the 1970's paramedics were allowed to intubate patients in the field (DeLeo,1977). This skill is constantly being assessed for a validity and proficiency.
- **ICEMA encourages the ownership of paramedics placement of this airway.**
- The paramedic is:
  - the expert when moving intubated patients
  - responsible for the airway until it is turned over to the emergency department (ED) physician and tube placement is verified.

Goals

- The purpose of this education module is to :
  - Maintain successful pediatric intubation in the field.
  - Reverse tissue hypoxia, by maintaining an open and protected airway.
  - Work with a challenging airway.

Objectives

- At the end of this presentation the EMS provider will:
  - Recognize signs and symptoms of tissue hypoxia.
  - Understand causes of respiratory compromise.
- Manage a challenging airway :
  - Using the C-E technique for proper bag valve mask ventilation and insertion of adjunct airways.
  - Review insertion of Nasal Gastric Tube and suction equipment.
- Develop an understanding of the basics of pediatric anatomy and compare differences of adult, pediatric, and neonate airways.

Chapter One

Assessment-Impending Respiratory Failure.

What causes respiratory compromise?

- Illness, asthma, pneumonia, croup, infection
- Foreign body, airway obstruction
- Seizures, traumatic brain injury
- Poisoning , allergic reactions

Impending Respiratory Failure Progression

Respiratory Failure	Tissue Hypoxia	Respiratory Arrest
• Agitation • Increase work of breathing • Pink, pale or dusky skin	• Decrease in agitation • Decrease in responsiveness • Pale, blotchy or dusky, cyanotic skin	• Apnea • Unresponsiveness • Limp muscle tone • Lack of chest movement

**Note: In pediatrics: respiratory arrest precedes cardiac arrest.
In adults cardiac arrest precedes respiratory arrest.

How do we approach these patients?

Respiratory Failure

- Calming the parent will calm the child.
- Approach patient with calm voice, using age appropriate language.

Tissue Hypoxia

- Move quickly with patient with rapid assessment and appropriate interventions.

Respiratory Arrest

- Immediately initiate life saving interventions for airway management.

General Assessment

- Pediatric Assessment Triangle-To use this tool you must undress your patient and assess the following:

Remember, an infant can become hypothermic in an air conditioned room. Keep them warm and covered!

Appearance

- LOC
- Muscle tone
- Body Position

Breathing-movement, effort normal or abnormal?

- Circulation-skin color

Breathing Assessment

- "Effort or work of breathing" indicates how fast you need to work with your patient.
- Upon assessment you discover:
  - **Retractions**-pulling of the skin above the breastbone, between ribs, or just below ribs *(progresses from lowest or softest part of the chest to the highest or rigid part of the chest).*
  - **Nasal flaring**-widening of bilateral nostrils, seen most commonly in infants and toddlers during inhalation.
  - **Head bobbing**- head tilts back and forth during inhalation and exhalation.
  - **Belly breathing-**sign of diaphragm fatigue.
- These patients are **EMERGENT** & need quick interventions to prevent respiratory failure.

What might we hear?

- **Stridor-**high pitched or low pitched sound on inhalation. *(upper airway)*
- **Wheezing-**a musical high pitched or low pitch sound usually heard with exhalation. *(lower airway)*
- **Grunting-**a rhythmic sound heard at the end of each exhalation. *(may be mistaken as a cough=auto CPAP)*
- **Crackles-**(Rales for the old school folks) a sharp crackling sounds heard during exhalation.
- **Gurgling-** bubbling sounds may be heard during exhalation or inhalation.

No sounds, an ominous sign…

Best approach for each patient?

- Neutral, head and jaw position.
- Airway management by all providers:
  - Supplemental oxygen
  - Bag Valve Mask
  - Oral airway or nasopharygeal airway
  - Proper seal with mask
- Advanced Airway with ALS measures
  - Endotracheal tube
  - King Airway
  - Nasal intubation *if*, the nares can accommodate a 7.0cm tube.

Chapter Two

Right tool for the right job.

Finding the right tool for the right job

Respiratory failure	Tissue Hypoxia	Respiratory Arrest
• Supplemental oxygen • Nasal cannula • High flow mask	• OPA or NPA • Bag-Valve-Mask ventilation	• Insertion of OPA airway • Bag-Valve-Mask ventilation • Intubation • NGT/OGT

A nasogastric tube will *decompress the stomach*. This is necessary when a distended abdomen presses on the diaphragm making it difficult to ventilate the patient.

Tissue Hypoxia

Tips & Tricks

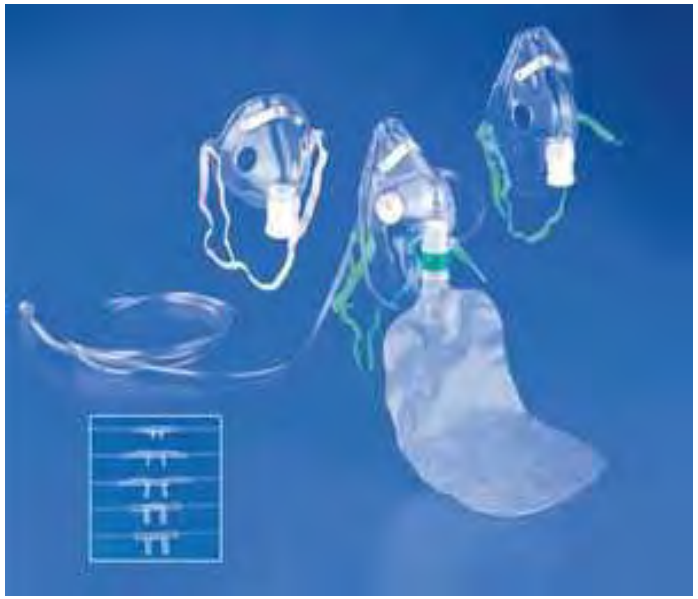
Promoting proper oxygenation

- Position your patient in a high Fowler's position
  - Rationale-helps to expand your patients lungs.
- Recognize what the tripod position is (anchors the pectoral muscles).
  - Rationale-the patient is compensating .
  - This is a tell-tell sign of impending respiratory distress.

- When using the nasal cannula:
  - Check size of prongs for proper fit, you may have to trim them for patient comfort.
  - Check to make sure the prongs curvature are in the proper position to provide oxygen flow.
  - Make sure the nasal cannula tubing is not to tight on ears, chin, or pulling. It's ok to pad the part of the tubing to prevent pressure on the ear lobes.

Sizes of Equipment

- Nasal Cannula sizes are adult, pediatric and neonate.
- Use appropriate size to match the nares.
- Neonatal, pediatric, adult masks.



Chapter Three

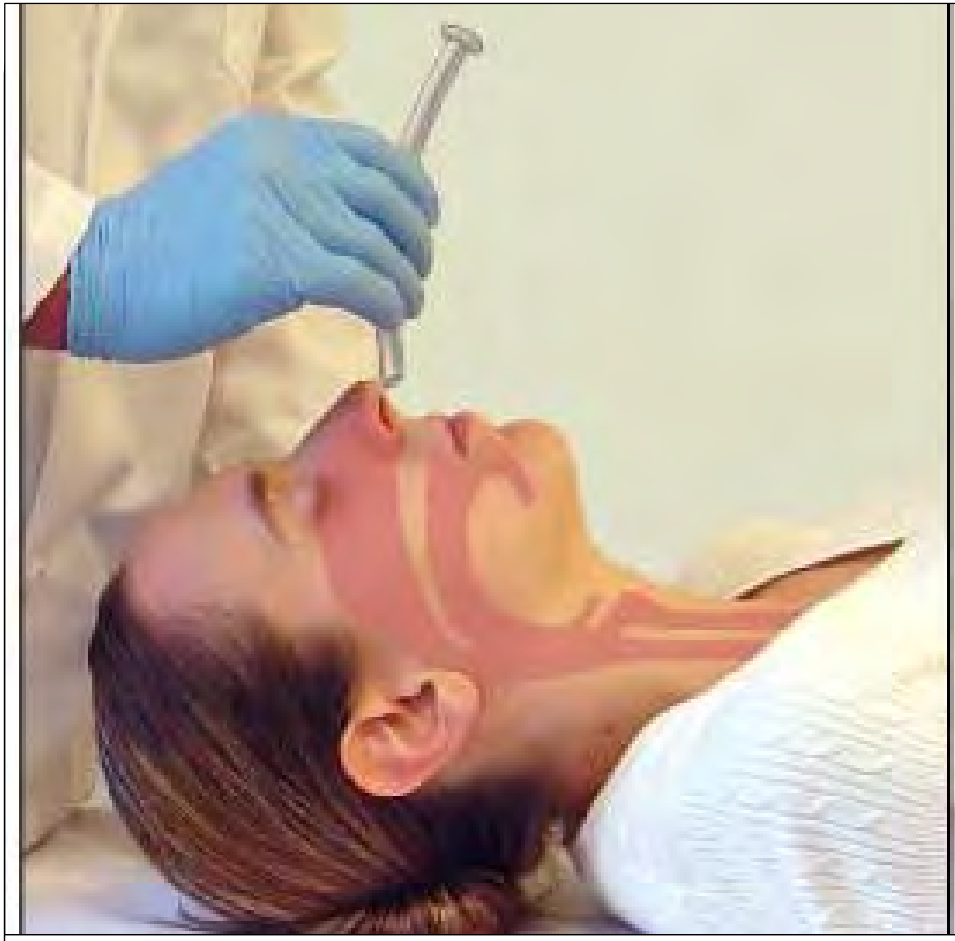
Respiratory Failure

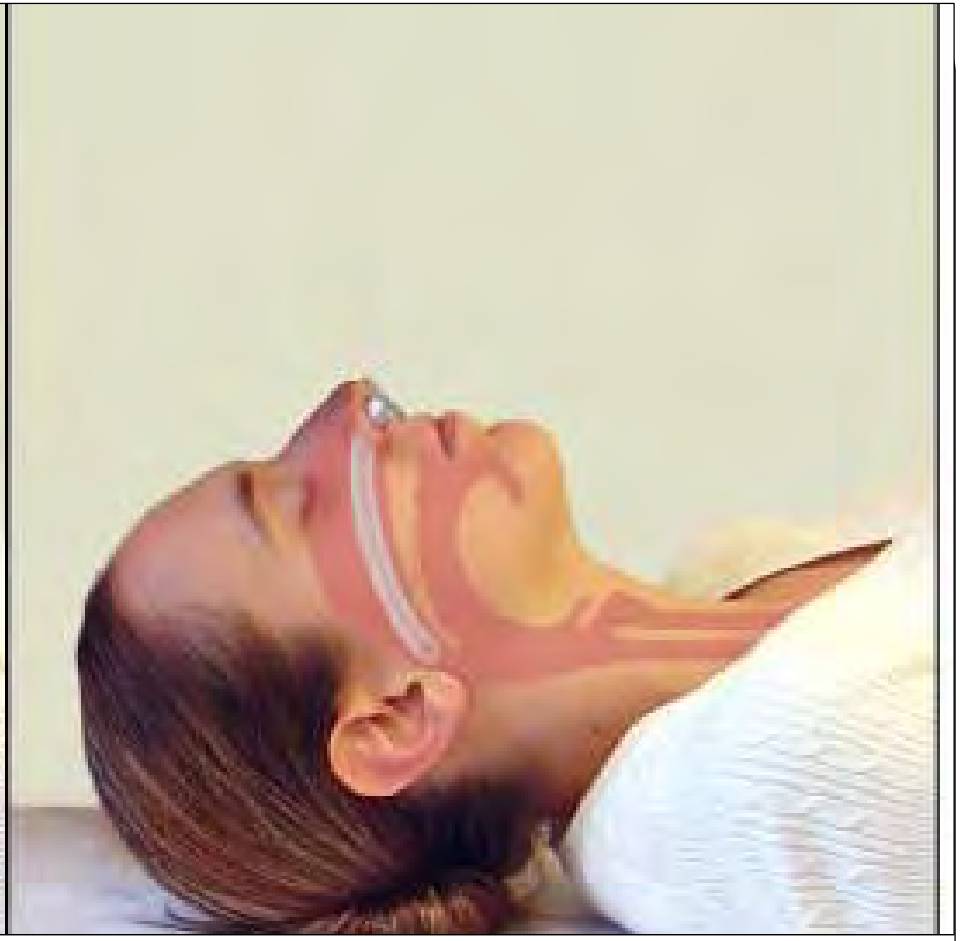
Respiratory Failure

- Patient cannot:
  - maintain or protect their own airway.
  - oxygenate or ventilate themselves.

Method:

- Open airway, provide supplement oxygenation and ventilation.
- Providing ventilation with Bag Valve Mask you must ensure:
  - Proper Seal using “C-E” method.





Oropharyngeal and Nasopharyngeal Airways

Tips & Tricks

OPA and NPA Airways

- Proper sizing for oropharyngeal airway (OPA) and nasopharyngeal (NPA) are essential for proper opening of the airway.
- Here is a review of measuring each device:

Tips & Tricks for Oropharyngeal Airway

- Tips for inserting airway:
  1) OPA is for the **unconscious** patient.
     - Never insert this airway in a conscious or semiconscious patient, they could *vomit, gag, aspirate emesis, and could compromise their own airway*.
  2) Sizing is important!
     - Place the OPA along jaw line with one end on the corner of patient's mouth to tip of the ear lobe.
     - Improper size of the OPA can cause obstruction of the airway by patient's tongue, pushing it back into their throat.
  3) Insert the OPA by placing the tip end of the airway into patient's mouth, pointing toward the roof the patients mouth, slide along the roof of the mouth, then rotating 180 degrees so the tip of the OPA points towards patient's mouth.
     - This airway should rest on the patient's lips.
     - The OPA will hold the tongue in place and should not slide back into the patient's throat.
     - Never tape the OPA in place.
     - If the patient starts to gag, remove airway.

Tips & Tricks for Nasopharyngeal Airway

- Tips for inserting airways:
  1) Location, Location, Location!
     - Know where to locate NPA's in your work setting.
     - All BLS airways should be treated aggressively and the NPA airway facilitates better BVM ventilation.
  2) Take the right size; here it is down and dirty:
     - Pick the size of the tube by the patients *height.* (Height is a better predictor of proper size NPA.)
  3) Lubricate!
     - Place a clump of lube on the lower half of the tube, don't be stingy with the amount, this will allow your tube to slide down easily with less trauma to the mucosa. Don't take a lot of time to decorate your tube with lube, time is of the essence.
  4) Pick the largest nares!
     - Place bevel in position and curve down.
     - Try the back and forth technique and then insert down.
     - Pick another nare, if it does not go in. Don't force it in!

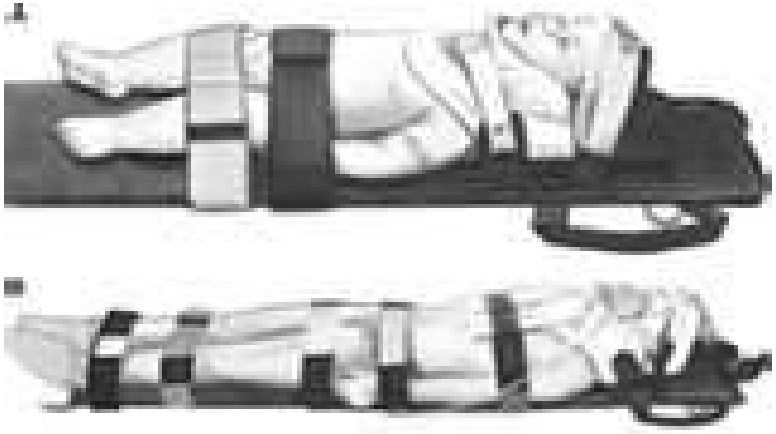
Do you know what the nasal cycle is?

How do we keep that airway open?

- Always place a towel under the shoulders of the child to have proper positioning and opening the airway.
- Stabilize the head, neck, & chest in a neutral position.

Any head movement may cause extubation, right-mainstem or esophageal intubation.

May use a ped-board to help stabilize the airway, (not for suspected neck injury).



Sizes of Bag Mask Ventilation Equipment

- Adult
- Pediatric
- neonate

Hazards of BVM

- Bag valve mask is more difficult than it appears, even for the experienced medical professional.
- Heightened emotions due to a dying child can influence perceptions of time, demand and actions.
  - *Remain focused.*
  - *Take a deep breath.*
  - *Continue engaging in the situation.*
- Gastric distention occurs when BVM is performed with poor airway control.

In pediatrics, the distended abdomen impedes diaphragm function, causing emesis with subsequent aspiration of gastric contents.

Ventilations

- Squeeze the bag to provide sufficient volume to expand the chest. **AND NO MORE!**

  There may be a tendency to want to empty the bag into the chest.

  This will over inflate the lungs and push air into the stomach! 
- The rate is based on airway resistance.
  - Upper airway obstruction: air will take longer to flow in.
  - Lower airway obstruction: it will take longer for air to escape.
- More pressure does not make the air flow any faster.

Ventilation is based on judgments made by the resuscitator.

Hand Ventilating the Breathing Patient

- Some patients have weak respiratory effort and may be difficult to overcome effective ventilation
- Two tactics to try:
  1. Rapid, shallow ventilations. Insert breaths before patient breathes.
  2. Low rate, large tidal volume.

     (This technique removes carbon dioxide, relaxes the patient, and allows you to take over respirations)

Trying to match breathing patterns to augment breaths rarely works.

Proper Ventilating Technique

- Pull jaw up into the mask

It is important *not* to dig your fingers into the jaw line of the patient while trying to create a better seal.

(*It makes it harder to breathe! Try it on yourself and see*…)

- Leaning too far forward over your patient will tilt your patient's head down and occlude the airway.

DO NOT LEAN FORWARD!

- Pull back on your elbows to help prevent closing the airway.

Fig. 1. Illustration of the position of the face mask. The standard face mask ventilation consists of placing the thumb and index finger on the body of the mask, whereas the other fingers move the mandible toward the upper teeth and extend the head. The continuous line represents the plane between the nose and the mandible. The arrow represents air leaks. Only one hand is pictured, and the oropharyngeal airway has been removed to see the position of the mask.

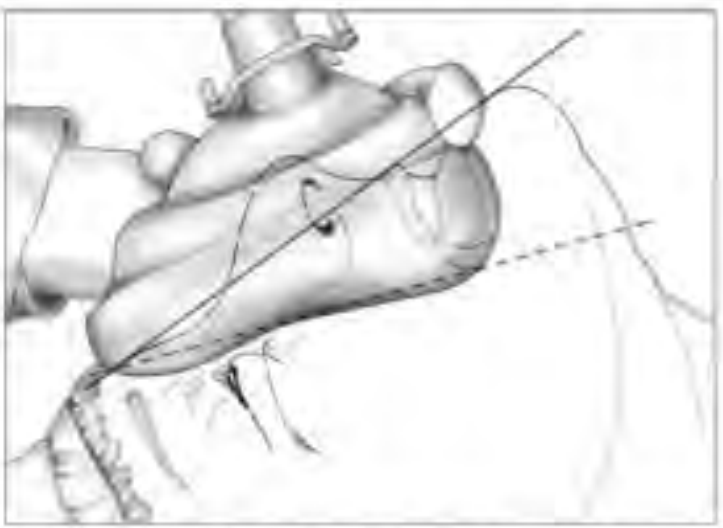


Fig. 2. Illustration of the position of the face mask. The mask was moved in the lower lip placement by repositioning the caudal end of the mask above the lower lip while maintaining the head extension. The *continuous line* represents the plane between the nose and the mandible. The *dashed line* represents the contact achieved between the mask and the face. Only one hand is pictured, and the oropharyngeal airway has been removed to see the position of the mask.

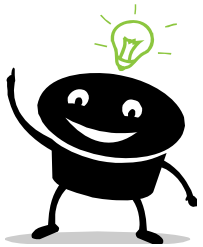
Proper seal technique with mask placement

Image Source Page: http://lifeinthefastlane.com/2011/02/own-the-airway/

What we don’t want to happen:

Vomiting

Gastric Distention



Always assume that there is food in the stomach.

Lets break it down!

- What is the best way to control emesis?
  - *Assume there is food in the stomach.*
  - Suction the airway.
  - Intubation to protect the airway.
  - Insert NGT or OGT & attach to suction.
  - Reduce the volume of air introduced in stomach.

Management of Emesis

- Why is it important?
  - Aspiration of emesis into the lungs can lead to aspiration pneumonia, prolonged tissue hypoxia.
  - Clearing the upper airway for better visualization.
  - Gastric distention management:
    - Immediate insertion of the NGT deflates the stomach. Provides more effective CPR, & facilitates chest expansion of the lungs.

Insertion of the NGT should be a regular practice on all intubated patients.

A short transport time should not dictate whether this procedure is performed. Comfort the patient, insert the NGT & the ease of ventilation will improve.

Suction Equipment

Airway & Suction Equipment :

- Flashlight or penlight
- Oxygen with regulator – 10 Lpm for 20 minutes
- Manual suction device
- Pulse oximetry device
- Stethoscope

Rationale for use of NGT or OGT

- Use on any intubated patient. This will facilitate effective ventilation.
- Oral route for patients with mid-facial trauma and all patients less than six (6) months of age.

CONTRAINDICATIONS:

- History of esophageal strictures, varices and/or other esophageal diseases.
- Caustic ingestion.
- Significant facial or head trauma.
- History of bleeding disorders.

Purpose of the NGT or OGT

- Notice in the first picture the distended abdomen with NO NGT or OGT inserted. The 2nd and 3rd pictures show a flat abdomen.
  - This made ventilating the patient difficult.
  - It also put patient at risk for aspiration related to vomiting.

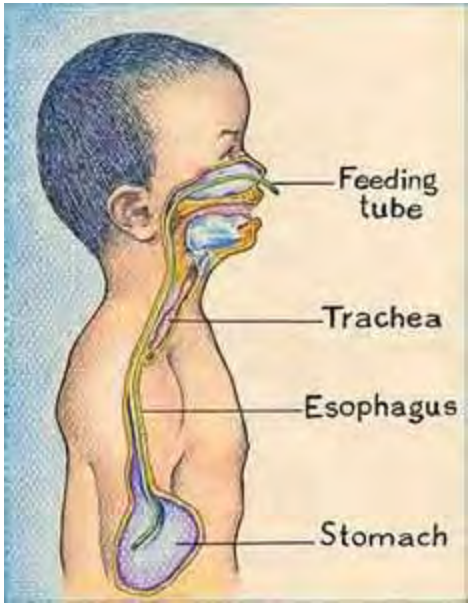
#1 NO NGT or OGT

#2 & 3 NGT or OGT INSERTED

Examples of Sizes for NGT or OGT

Method:

- Explain procedure, then position patient in high Fowlers position unless otherwise contraindicated and select appropriate size NGT or OGT: adults 16-18fr, adolescents 12-14fr, children 8-10fr or infants 5-6fr.



Insertion of NGT or OGT

- Measure and mark the NGT or OGT tube for proper insertion length and have suction equipment readily available.
  - NGT -- Combined distance between the tip of the nose to the ear lobe to the xiphoid process.
  - OGT -- Combined distance between the corner of the mouth to the ear lobe to the xiphoid process.
- Examine both nares to determine nares with best airflow or examine oropharyngeal cavity for obstructions or secretions then:
  - Lubricate distal third of gastric tube with a water-soluble lubricant.
- Gently pass tube posteriorly along floor of nasal cavity.
  - Instruct patient to swallow (if conscious).
  - If resistance is met while using the nasal route, remove and attempt other nostril.
  - Slowly rotate and advance tube during insertion until pre-designated mark is at tip of nose.
  - If resistance is met, remove tube and attempt again.

Chapter Four

Respiratory Arrest

When do you need to intubate?

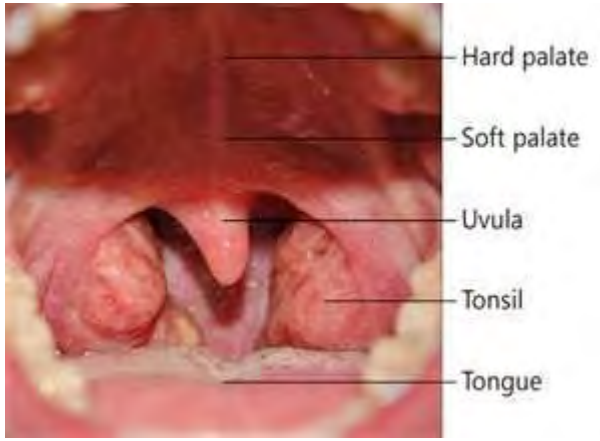
- Apneic
- Unable to effectively BVM the patient.
- Unresponsive or have poor respirations may benefit from intubation.
- Decisions the paramedic needs to make:
  - If your ETA is short and you are getting positive ventilation with the BVM, STICK WITH IT!
  - If you have a long transport time with little resources, intubation maybe a better way to secure and manage the airway and secretions.
  - Capnography should be used to identify poor ventilation. A pulse ox is of limited value because it depends on peripheral perfusion. It takes several minutes for the pulse oximetry to read real time oxygenation/ventilation.

Endotracheal Intubation

- Equipment needed:
- Laryngeal scopes:
  - Laryngeal blades - #0, #1, #2, #3, #4 curved and/or straight
- Laryngoscope handle with batteries – or disposable handles
- Sizes:
  - Endotracheal Tubes, uncuffed – 2.5, 3.0, 3.5
  - Endotracheal Tubes, uncuffed – 4.0 or 4.5, 5.0
  - ET Tube holders – pediatric
- Magill Forceps – Pediatric

Special Considerations

- **<u>Differences between adult, peds, and neonate airway</u>:**
- Shapes of anatomy of upper airway:
  - Neonates has a very narrowed shaped airway:
  - Child has a more peaked shaped airway.
  - Adult have larger opening of the airway, wider curved shaped:



Adult vs. Pediatric Airway

*Anatomy	Adult	Pediatric
Tongue	Normal	Large (in relation to the jaw). *May interfere with laryngoscope blade.*
Epiglottis Shape	Firm, flatter	Floppy, omega shaped. *May impede visualization of the airway.*
Epiglottis Level	Level of C5-C6	Level of C3-C4 (closer to the vocal cords)
Trachea	Wider, longer	Smaller, shorter
Larynx Shape	Columnar	Funnel Shaped *May interfere with Heimlich maneuver, especially with soft foods.*
Larynx Position	Straight up and down	Angles posterior away from glottis
Narrowest Point	At the level of vocal cords (the reason for cuffed tubes)	Sub-glottis region or cricoid cartilage (the reason for uncuffed tubes)
Lung Volume	6000 ml	250 ml at birth

The base of the tongue is at the level of the mandible.

Myth: Vocal cords are not more anterior in children.

LIFT UP & AWAY!

Don't tilt and angle back the laryngoscope or rotate your wrist… (the tongue will be in your way and the vocal cords will be *made* anterior.)

**Pediatric Airway & Respiratory Physiology* (Kache, 2009).

Chapter Five

Other airway considerations

Blind Airway Insertion

ICEMA Protocol: Pediatric Bougie or King Airway only.

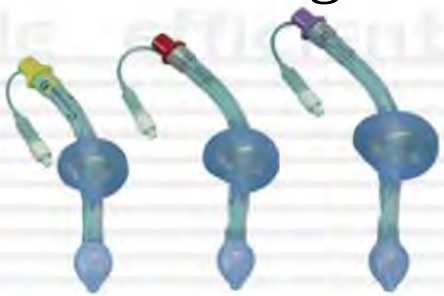
- What is a blind airway?
  - This is an airway that the anatomical structures are not easily visualized.
  - Causes:
    - Anatomy (e.g. scoliosis, neck arthritis)
    - Airway obstruction
    - Anaphylaxis
- What tools work best for this type of airway?
  - Bag Valve Mask
  - King airway

Always suction airway to remove secretions.

King Airway

- King LTS-D Adult: 4-5 feet: Size 3 (yellow)
- 5-6 feet: Size 4 (red)
- Over 6 feet: Size 5 (purple)
- King Pediatric Sizes: 35-45 inches or 12-25 kg: Size 2 (green)
- 41-51 inches or 25-35 kg: Size 2.5 (orange)

Additionally, the KING LT is:
- Designed to allow up to 30 cm H_2O positive ventilation pressure
- Reusable up to 50 autoclave cycles



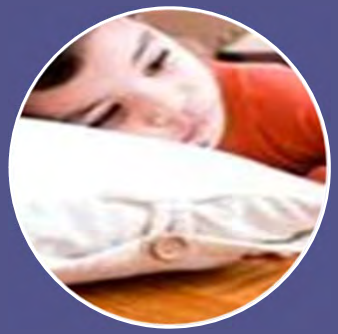
COLOR	Yellow	Red	Purple
SIZE	3	4	5
PATIENT SIZE	Adults less than 61" (155 cm) in height	Adult 61"-71" (155-180 cm) in height	Adults greater than 71" (180 cm) in height
CUFF PRESSURE	60 cmH_2O	60 cmH_2O	60 cmH_2O
CUFF VOLUME (# FILLED WITH SYRINGE)	60 ml	80 ml	90 ml
ITEM #	KLT 103	KLT 104	KLT 105

CUFF PRESSURE GAUGE	ITEM # KLT 900

Chapter Six

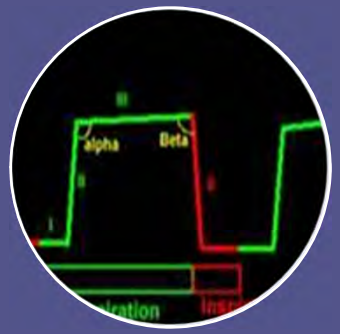
Monitoring and Reassessment Adjuncts

What we need to OBSERVE:



Monitoring Skin Signs

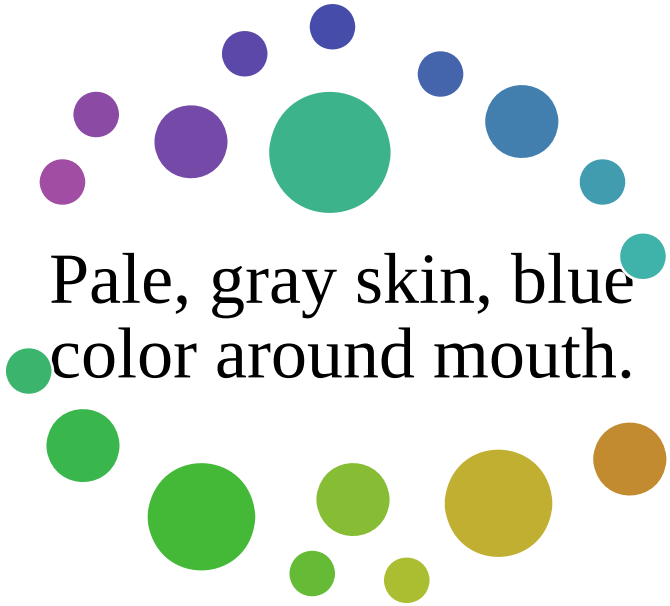
SpO2



End tidal CO2/
WAVEFORM
CAPNOGRAPHY

Vital Signs

Worsening signs of respiratory distress



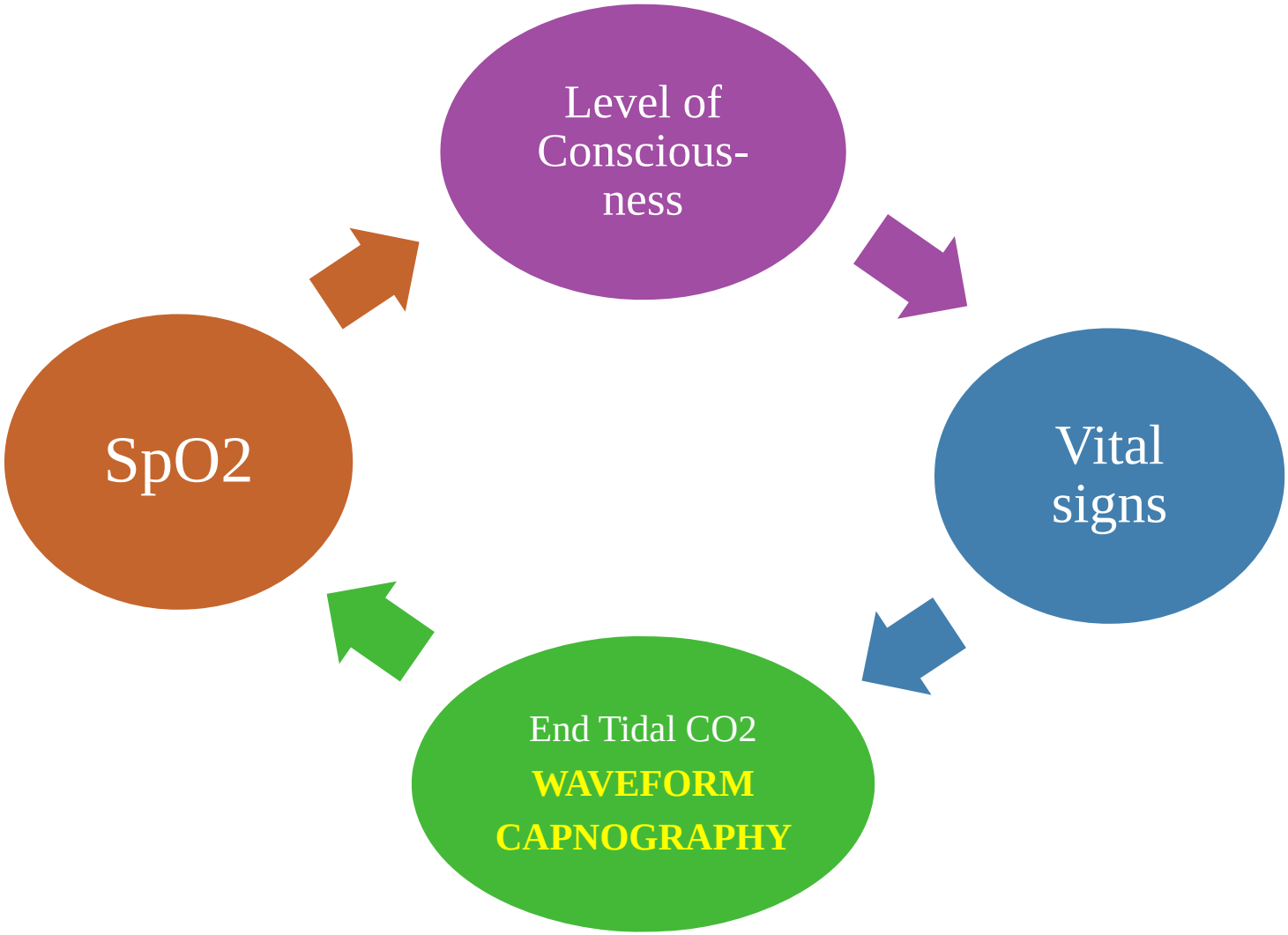
Pale, gray skin, blue color around mouth.

Sweat present on the head, skin feels cool and clammy.

Increase respiratory rate, grunting with each exhale and possible nasal flaring.

Decreasing respiratory rate without chest expansion is a result of diaphragm fatigue and impending respiratory fatigue or arrest.

Continuous Monitoring & Assessment



Why it's important to monitor?!?

- Vital Signs
  - Bradycardia occurs as a result of tissue hypoxia or hypothermia.
  - Monitoring the Sp02 is a tool we have to watch oxygenation level, ***don't let it fool you!*** The 02 saturation dropping is usually a late stage of the pediatric patient with poor ventilation. Watch those skin signs, and what your patient is doing.

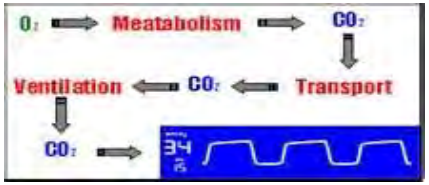
Remember treat your patient, not the monitor.

  - Tube migration can happened at anytime; a bump in the road during transport, an aggressive transfer from gurney to gurney, or even simple suctioning procedure.
  - Avoid inadvertent extubation…Monitor your patient & hold onto the tube with every move of the patient and especially during transfers.

Every breath you take, every move you make…I'll be watching you!

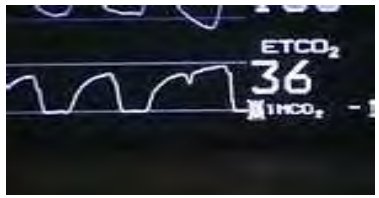
Continuous Waveform Capnography Monitoring:

- Required for all EMS providers that have the capability of monitoring.
- Required for intubated patients.



- Essential tool used when providing various methods of oxygen.
- ↑CO2 & ↓HR is the earliest sign that your patient is deteriorating.
- Monitors ventilation more acutely and faster than pulse oximetry.

Re-evaluate & re-visualize tube with a laryngoscope after any significant changes or continuous waveform capnography measurement<10.



Chapter Seven

Preventing Dislodgment of Tube

Gurney to Gurney

- Most advance airway tubes are dislodged during patient movement:
  - transfer from ambulance gurney to hospital gurney
  - CPR
  - application of cervical spinal immobilization
  - taking an x-ray

Everyone has a role!

The intubating paramedic is responsible for the tube.

- The paramedic or the hand-ventilating provider:
  - Stands at the head of the gurney, gives the commands for transfer onto the hospital gurney.

After any significant movement or transfer…

REASSESSMENT of the tube is mandatory.

Ownership of Airway

- ICEMA requires each paramedic to take ownership of tube!
- Turning your patient's airway over to a physician, Respiratory Care Practitioner (RCP) or Therapist (RT) is not good enough.

During transfer of care, positive confirmation by the ED physician regarding the placement of the tube is required.

- The physician must sign off on your run sheet/Toughbook !

Thank you for your participation!!

Learn more about airway management of the pediatric in:

Module II Case Scenarios

References

- Anshuman, Sharma, MD. & O'Connor, D.M, *Physiology of the Airway-The Pediatric Airway.* M Myers, III J.B. Lippincort Company Philadelphia, 1995.
- Brownstein D. *Prehospital Care of Pediatric Emergencies.* Sudbury, MA; Jones & Bartlett, 1997; 17-24.
- DeLeo BC. Endotracheal intubation by rescue squad personnel. Heart Lung. 1977 Sep-Oct;6(5):851-4.
- Dorfman, A. MD., A near fatality in a 6-month-old boy from an aspirated toy. *Air Medical Journal.* March 2011, Vol. 30, Issue(2).
- Pictures obtained from world wide web, 2011-2012.
- ICEMA Protocols 14010,14060,14050,14040, 1080, 10080.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